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EFFECTS OF CASUALTY EVACUATION ON PATIENTS OF HEAD INJURY – A RETROSPECTIVE OBSERVATIONAL STUDY

Neurosurgery

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ABSTRACT

Background:- A lot of patients of head injury are transferred to tertiary care centres for management by neurosurgeons. They are evacuated either by road or air. Many a time these patients arrive in a clinicoradiligical deteriorated state.
Methods:- All patients of moderate and severe head injury that were transferred in from peripheral hospitals for management by Neurosurgeon between Jan 2017 to Dec 2017 were analyzed for their clinical status at the time of evacuation to their clinical status on arrival.
Results:- 20 patients deteriorated, 19 required intervention, one was already intubated and his CT showed only increased edema, of the 19, 11 required surgery, 03 re-surgery, 5 required intubation and no surgery.
Conclusion: - Neurosurgeons are not available at all hospitals thereby leading to the early evacuation of the patients. The frequent movements and travelling either by road or air can have fluctuations in the ICP and hypoxia/hypotension/hyper-hyothermia during travelling can aggravate secondary insult to brain. Although what effect these ICP fluctuations have on the brain is not confirmed but these are better avoided.

KEYWORDS

Head injury, Casualty evacuations, ICP, decompressive cranietomy

A tertiary hospital in the armed forces receives a significant number of head injuries from its dependent hospitals for management of head injuries. It was observed that several patients of moderate to severe head injury on arrival were in a lower GCS than they were at the time of evacuation from the peripheral hospital. NCCT showed either an increase in edema/fresh lesions compared to the previous scan. In effect some required either re-surgery or fresh surgery or intubation. So a study was conducted to observe and analyze the presentation before and after evacuation of these patients and review the literature as to study the reasons for the clinico-radiological deterioration.

AIM:

To study and analyze the clinical status of patients of moderate to severe head injury evacuated to a Neurosurgical centre from a peripheral hospital for further management between Jan 2017 to Dec 2017.

Inclusion Criteria:

All patients of moderate and severe head injuries who were transfered in from peripheral hospitals between Jan 2017 to Dec 2017 were included in the study. Head injuries were classified as mild, moderate and severe based on the GCS score of 13 to 15, 9 to 12, and 8 and below respectively. Patients with any associated injury/injuries which were in itself an independent risk factor for mortality were excluded. Associated small bone fractures like phalanges/clavicle/isolated rib fractures without any hemopneumothorax were included.

MATERIALS AND METHOD:

This is a retrospective observational study done between Jan 2017 to Dec 2017. A total of 97 patients of head injury were transferred in from peripheral hospitals out of 248 head injury managed at the hospital, with 151 being direct admissions, **chart 1**. The details about time of injury, time when evacuated, associated injuries, cause of death in fatal cases were obtained from the patient's case sheet retrieved from the Department of statistics. 56 patients among transfer in and 98 patients among direct admissions were of moderate to severe head injury based on the inclusion criteria, who qualified for the study. There were 08 air evacuations, rest were by road, none by train. Among the air evacuation 05 were helicopter, 03 fixed wings aircrafts; this depended on the distance of travel and not the clinical status of the patient. Time of travel ranged from two hours to seven hours.

Twenty patients had deteriorated clinically on arrival, among them 19 required emergency interventions. One patient who deteriorated was already intubated and his NCCT revealed increase in diffuse cerebral edema which responded to antiedema measures. Emergency surgery done in 11, re-surgery in 03, 05 patients required intubated only. Three patients who underwent surgery were referred from centers where the Surgeon was not available. Re-surgeries done were revision of the craniotomy and contusectomy, all primary surgeries were decompressive hemicraniectomy and evacuation of acute subdural hematoma, six out of eleven also underwent contusectomy. No patient had epidural hematoma since most were operated at the peripheral hospital itself. There were a total 18 fatalities (18.55%) out of 97 transfer in patients and all of them were in the moderate and severe head injuries. Among direct admissions there were 17 (11.25%) fatalities out of 151, so there was a increase in the fatal cases among the transfer in patients. Causes of death in these cases were severe TBI - 39%, Sepsis – 24%, others (which include myocardial infarction, pulmonary thromboembolism, arrhythmias, ARDS) 37%, suggesting extensive brain/brain stem injuries were the leading cause. Only the data regarding the clinical status of the patients before evacuation and on arrival at the tertiary care centre and the causes of fatalities were analysed.

DISCUSSION:-

With good pre-hospital care, evacuations to hospitals, advances in imaging and the management, the mortality of head injury seems to have reached a plateau, however as we see in the analysis above, 20(20.62%) patients had deteriorated on arrival. We felt that this required analysis.

The causes could be faulty evaluation at referral centre; pt was not fit to travel, poor clinical assessment however most of the hospitals from where the patients were evacuated were equipped with basic specialties which included surgeon, anesthesiologist, who were well versed with the nuances in evacuating critical patients. So it is possible that they deteriorated en route. Patient can have hypoxia, hypoventilation/ hyperventilation or even seizures en route since most ambulances did not have a ventilator and patients were evacuated using mechanical ventillaton using ambu bag. Patients evacuated were in the acute stages and the secondary effects could have been evolving. Also it is worth analyzing if the process of evacuation which includes multiple shifting of the patient, the frequent movements during travelling, and the altitude changes in flight especially during take-off and landing, unpressurised aircrafts etc had any effect on the brain.

Despite the best modes of evacuations, transport and travelling does add stress to the patient. However to attribute only this to the deterioration of the patients would not be fair, since there could be a faulty evaluation at the primary referral centre, or a seizure activity/episodes of hypoxia/hypotension, hypo-hyperthermia during the transport/travelling which may not be related to the evacuation per-se. Nevertheless one cannot completely rule out the stress effect of transportation on patients completely. There are studies in which ICP changes were monitored in head injury patients undergoing air evacuations, however there are none studying the effects of evacuation by road.

Primary injury to the brain occurs due to mechanical insult; secondary injuries are non- mechanical damage that occur during the evolution of injury pattern after the primary injury. Secondary injuries may be induced by hypotension, hypoxia, inadvertent hypo or hyperventilation, and hyperthermia and can worsen the outcome. Prehospital hypotension or hypoxia have been reported to double the mortality rate.[1,2]

In severe TBI the mortality is 30-35%. 25% of pts with mass lesions after TBI will deteriorate 2-3 days after injury (contusions), 2/3rd pts with severe TBI do not have any significant mass lesion on initial CT scan, which can appear later, only 1/3rd go in for surgery. Main focus in the management is to prevent secondary injury.

Based on the facts above, it is possible that the patients who deteriorated may have deteriorated due to the natural progression of the condition which would have occurred irrespective of the fact that the patient was evacuated or not. However did evacuation contribute/hasten the process?? As mentioned above, secondary injuries can be caused inadvertent hypo or hyperventilation, and hyperthermia, which is possible during evacuation and there were some patients who were evacuated unintubated. Also literature is replete with recommendations of better outcomes with early surgical intervention and then evacuation, whether it's an acute EDH and acute SDH[3]

A few studies have looked at the impact of transfer of TBI patients to a neurosurgical care facility for management and its effects. Stone et al[4] found that for acute SDH, the mortality rate of the patients who had transited through another hospital was 76%, compared with 50% of the directly admitted patients. Immediate bur hole decompression/rapid temporal decompression and evacuation of the clot by a trauma surgeon in deteriorating patients, prior to transfer to a neurosurgical facility where a standard/formal craniotomy is followed has shown to save lives with a good functional outcome.[5,3] However these articles studied the effects of delay in surgery for evacuating mass lesions/decompression and not the effects of transportation on the clinical condition of the patient.

Patients who are intubated and undergoing bag ventilation are especially at risk for inadvertent hyperventilation, which leads to vasoconstriction and brain ischemia if prolonged, and worsens outcomes. Also they can have hypothermia or hyperthermia which has been demonstrated to be harmful.[6] In addition; secondary injury may be exacerbated when the cerebral perfusion pressure (CPP) fall less than 60mmHg. If MAP falls below 60mmHg and/or the ICP increases above 20mmHg, then the CPP decreases, again worsening outcome. Increased ICP can be caused by bleeding or edema from hypoxia, ischemia, or injury. All these can occur during casualty evacuations either as part of the evolution of the condition or due to the effects of transportation. Maintaining a normal ICP, normal MAP, and a CPP above 60 mmHg is associated with improved outcomes.[7,8,9,10]

HEAD INJURY AND AIR EVACUATION:

The goal of treatment during the acute phase of TBI is to prevent secondary brain injury while rapidly transporting the patient to definitive care.[11] Here's where air evacuations come into play. Casualties evacuated by air may be relatively susceptible to hypoxia due to the lower partial pressure of oxygen at altitude. As per Cottrell JJ, Lebovitz BL et al[12] at cabin pressures equivalent to 5000 to 8000 feet, passengers without medical problems regularly have a peripheral oxygen saturation level of 89%. In patients with poor perfusion, this may decrease further.[13] Therefore air evacuation of casualties with TBI may place them at increased risk for secondary brain injury from tissue hypoxia.[14]

A study by Col J Ray et all in 2015, found significant changes in ICP in patients of head injury with intraventricular catheter ICP monitoring who were evacuated by air. The main findings of this study are the following: (1) there were instances of ICPs greater than 20 mm Hg and changes in ICP ± 50% of baseline values during transport, (2) takeoff and landing were identified as events that produced the greatest alterations in ICP.[15] They also found that noise, vibration associated with takeoff and landing were significant. Patients who underwent hemicraniectomy before and sedation during transportation had lesser fluctuations in the ICP. They were however not able to conclude definitively, due to the limitations of the study, whether these fluctuations of ICP had any impact on the outcome of the patients. Moreover can these be applied to evacuation by surface transport (road) is a matter of debate despite the fact that there is significant noise, vibration and jerks associated.

CONCLUSION:

The analysis revealed multifactorial causes for the clinical deterioration of the transfer in patients. This study lacked standardization among the patients studied, few patients were transferred since there were no surgeons available. A more standardized study would be required to definitively attribute causes to the transportation and casualty evacuations. There is an association of air evacuation ICP changes, however there are no studies to show effects of road travel on head injury although some common factors are associated with both air and road travel like noise, vibrations, jerks. So it can be taken with some amount of certainty that casualty evacuation does have some deleterious effect on head injury and the referring surgeon should cater for this entity during evacuation and further decompressive surgery before casualty evacuation does cause less ICP fluctuations and is therefore recommended and general surgeons to be trained accordingly.

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